

Course Unit	Biotechnological processes		Field of study	Engineering and related technics	
Bachelor in	Biology and Biotechnology		School	School of Agriculture	
Academic Year	2022/2023	Year of study	2	Level	1-2
Type	Semestral	Semester	2	ECTS credits	6.0
Workload (hours)			162	Contact hours	
			T	30	TP
			PL	30	TC
			S	-	E
			OT	4	O
			Code		
			9029-510-2205-00-22		

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) António Manuel Coelho Lino Peres

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Identify and understand the processes involved in heat and mass transfer;
2. Determine the kinetic equation and its relation to microbial processes kinetics;
3. Identify batch reactors, steady-state flow reactors – mixed and plug flow reactors - and fed batch reactors;
4. Identify and understand the microbial growth stages in batch mode in the presence of one or multiple substrates;
5. Identify growth kinetics with substrate inhibition and/or product inhibition and/or toxics inhibition;
6. Identify the different types of products produced by microorganisms;
7. Calculate yields of batch cultures;
8. Know the main unit operations used for separation/purification of biotechnological products.

### Prerequisites

Before the course unit the learner is expected to be able to:  
Perform integral and differential calculus.

### Course contents

Fundamentals of Heat and Mass Transfer; Chemical kinetics; Operation modes of reactors; Introduction to the Fermentation Process: stoichiometry and microbial processes kinetics, growth kinetics, type of products; yields; Separation processes.

### Course contents (extended version)

1. Fundamentals of Heat and Mass Transfer;
2. Chemical kinetics:
  - Kinetic equations;
  - Order concept;
  - Kinetic constants.
3. Operation modes of reactors:
  - Batch reactors;
  - Steady-state flow reactors – mixed and plug flow reactors;
  - Fed batch reactors.
4. Introduction to the Fermentation Process:
  - Stoichiometry and processes kinetics taking place in the presence of one or multiple substrates;
  - Growth kinetics with substrate inhibition and product inhibition, or by toxic compounds;
  - Primary and secondary products;
  - Yields calculation.
5. Separation processes:
  - Filtration;
  - Centrifugation;
  - Lyophilization.

### Recommended reading

1. Octave Levenspiel, 1999, "Chemical Reaction Engineering", 3rd Edition, John Wiley.
2. Fogler, H. S. , 1999, "Elements of Chemical Reaction Engineering", Prentice – Hall;
3. Stanbury, P. F. , Whitaker, A. and Hall, S. J. 1995, "Principles of Fermentation Technology", 2nd Edition, Elsevier Science Ltd. ;
4. Fonseca, M. M. e Teixeira, J. A. , 2007, "Reactores Biológicos: Fundamentos e Aplicações", Lidel;
5. Gomes de Azevedo, E. e Alves, A. M. , 2009, "Engenharia de Processos de Separação", Coleção Ensino da Ciência e da Tecnologia, IST Press.

### Teaching and learning methods

Theoretical classes: exposure of the topics related to the program of the course; Practical classes: it is intended to solve exercises.

### Assessment methods

1. Final Evaluation - (Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100%
2. Continuous Evaluation - (Regular, Student Worker) (Final, Supplementary)
  - Final Written Exam - 85%
  - Practical Work - 15%

### Language of instruction

1. Portuguese
2. Portuguese, with additional English support for foreign students.

## Electronic validation

António Manuel Coelho Lino Peres	Maria da Conceição Constantino Fernandes	Altino Branco Choupina	José Carlos Batista Couto Barbosa
05-12-2022	05-12-2022	05-12-2022	09-12-2022